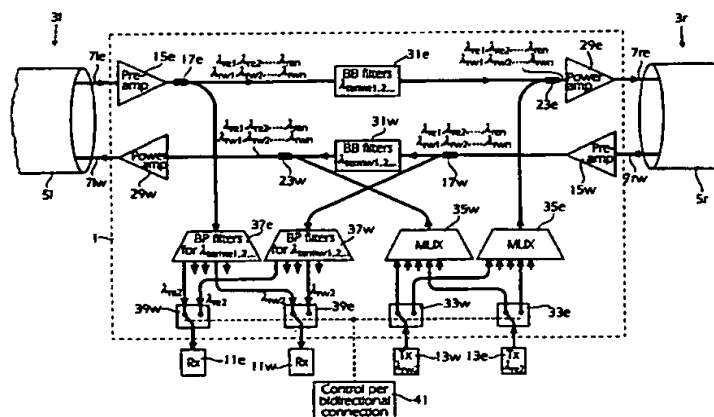




## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification <sup>7</sup> : <b>H04B 10/213, H04J 14/02</b>		<b>A3</b>	(11) International Publication Number: <b>WO 99/65164</b>
			(43) International Publication Date: 16 December 1999 (16.12.99)
(21) International Application Number: <b>PCT/SE99/00993</b>		(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).	
(22) International Filing Date: <b>8 June 1999 (08.06.99)</b>		Published <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>	
(30) Priority Data: <b>9802070-4</b> <b>10 June 1998 (10.06.98)</b> <b>SE</b>			
(71) Applicant: <b>TELEFONAKTIEBOLAGET LM ERICSSON</b> (publ) [SE/SE]; S-126 25 Stockholm (SE).			
(72) Inventors: <b>EGNELL, Lars; Klubbvägen 14, S-133 37 Saltsjöbaden (SE). JOHANSSON, Bengt; Naumansväg 19, S-129 38 Hägersten (SE). BATCHELLOR, Robert; 8 Mill Road, Angmering, West Sussex BN16 4HS (GB). WOOD, Nigel; Paynters Wood Farm, Evenley, Brackley, Northants NN13 6SB (GB). ÖBERG, Magnus; Pettersbergsvägen 16 A, S-129 40 Hägersten (SE).</b>			
(74) Agents: <b>LINDÉN, Stefan et al.; Bergenstråhle &amp; Lindvall AB, P.O. Box 17704, S-118 93 Stockholm (SE).</b>		(88) Date of publication of the international search report: <b>2 March 2000 (02.03.00)</b>	

(54) Title: AN OPTICAL WDM NETWORK HAVING AN EFFICIENT USE OF WAVELENGTHS AND A NODE THEREFOR



## (57) Abstract

An optical fiber network of WDM type comprises two fibers (7e, 7w) which carry light signals propagating in opposite direction and which are arranged in a ring configuration, in which always one link (2) between two neighbouring nodes is inactive but provides a standby-link which is used for failure in another link, in the case of which the previously inactive link is made active. An add and drop (1) node used in the network has band blocking filters (31e, 31w) connected in a fiber (7e, 7w) between a drop coupler (17e, 17w) and an add coupler (23e, 23w), taking out a share of the light power in each direction to be received through bandpass filters (37e, 37w) in receivers (11e, 11w) and adding new wavelength channels produced in transmitters (13e, 13w) respectively. Switches (39e, 39w; 33e, 33w) are used for receiving and transmitting on the wavelength channels in correct directions. The positions of the switches can be changed when the inactive link (2) has to become one of the two links directly connected to the node. A very efficient use of the wavelength channels in the network can then be achieved for nodes having a minimum of in-line components and particularly a minimum of in-line filtering components.

**FOR THE PURPOSES OF INFORMATION ONLY**

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LI	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 99/00993

## A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H04B 10/213, H04J 14/02

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: H04B, H04J, H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0769859 A1 (PIRELLI CAVI S.P.A.), 23 April 1997 (23.04.97), see the whole document --	1-5
P,A	WO 9849794 A2 (TELEFONAKTIEBOLAGET LM ERICSSON), 5 November 1998 (05.11.98), cited in the application (whole document) --	1-5
A	WO 9624998 A1 (TELEFONAKTIEBOLAGET LM ERICSSON), 15 August 1996 (15.08.96), page 1, line 6 - page 3, line 6, claims 1-5, cited in the application --	1-5

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents	"I" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier document but published on or after the international filing date	"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

Date of mailing of the international search report

20 December 1999

11 -01- 2000

Name and mailing address of the ISA/

Authorized officer

Swedish Patent Office  
Box 5055, S-102 42 STOCKHOLM  
Facsimile No. +46 8 666 02 86

Roger Bou Faisal/cs  
Telephone No. +46 8 782 25 00

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 99/00993

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 9808322 A1 (ALCATEL ALSTHOM COMPAGNIE GENERALE D'ELECTRICITE), 26 February 1998 (26.02.98), see the whole document  --	1-5
Y	EP 0769859 A1 (PIRELLI CAVI S.P.A.), 23 April 1997 (23.04.97), column 5, line 4 - line 39, claims 1-6, abstract  --	6-8
Y	EP 0716521 A2 (CSELT CENTRO STUDI E LABORATORI TELECOMUNICAZIONI S.P.A.), 12 June 1996 (12.06.96), column 4, line 22 - line 48; column 7, line 5 - line 17, claims 1-10, abstract  --	6-8
A	US 5546403 A (CHIYOKO YAMAMOTO ET AL), 13 August 1996 (13.08.96), column 1, line 27 - line 62, abstract  --	6-8
A	EP 0788249 A1 (PIRELLI CAVI S.P.A.), 6 August 1997 (06.08.97), column 3, line 7 - column 4, line 40, claims 1-6, abstract  -- -----	6-8

# INTERNATIONAL SEARCH REPORT

International application No.  
**PCT/SE99/00993**

## Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
  
2. ☐ Claims Nos.:  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

## Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

**See next page.**

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
  
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

### Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.  
☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.  
PCT/SE99/00993

1st invention: claims 1-5.

2nd invention: claims 6-8.

The special technical feature of the invention according to independent claim 1 is an add/drop node in an optical fiber WDM network, the network having a ring configuration and a band blocking filter arranged between a drop and add coupler, The invention is characterized by the switch connections to the receiver or to the transmitter, for allowing the receiver to receive, and the transmitter to transmit from respectively in either one of two opposite directions.

The special technical feature of the invention according to claim 6 is an optical WDM network having a ring configuration with add/drop nodes characterized by that the nodes are arranged to use at least one wavelength band in such a way that the wavelength band is used by at least two separate first nodes for transmitting to second nodes, which are different from each other, in a first direction and is used by only one third node to transmit to a fourth node in a second direction opposite to the first direction.

It is not mentioned in the independent claim 6 something about the filter and the switch connections, which are the special technical feature of claim 1. Thus, the two inventions are not considered to have the same or corresponding special technical feature. Therefore, the application contains two independent inventions and lacks in unity.

INTERNATIONAL SEARCH REPORT  
Information on patent family members

02/12/99

International application No.  
PCT/SE 99/00993

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0769859 A1	23/04/97	AU 707370 B	08/07/99
		AU 7023696 A	24/04/97
		BR 9604432 A	23/06/98
		CA 2188208 A	20/04/97
		IT 1277204 B	05/11/97
		IT MI952154 A	21/04/97
		JP 9172449 A	30/06/97
		NZ 299605 A	19/12/97
		US 5903371 A	11/05/99
WO 9849794 A2	05/11/98	AU 4641497 A	11/05/98
		AU 7356298 A	24/11/98
		SE 9701668 A	31/10/98
WO 9624998 A1	15/08/96	AU 2632695 A	19/01/96
		BR 9508068 A	12/08/97
		CA 2211532 A	15/08/96
		EP 0766591 A	09/04/97
		EP 0808536 A	26/11/97
		FI 965124 A	19/12/96
		JP 10505272 T	26/05/98
		JP 10513326 T	15/12/98
		PL 317646 A	14/04/97
		SE 503258 C	29/04/96
		SE 9500404 A	29/04/96
		US 5759505 A	02/06/98
		US 5963348 A	05/10/99
WO 9808322 A1	26/02/98	AU 4021297 A	06/03/98
		CA 2231628 A	26/02/98
		CN 1198276 A	04/11/98
		EP 0861537 A	02/09/98
		GB 9617396 D	00/00/00
EP 0769859 A1	23/04/97	AU 707370 B	08/07/99
		AU 7023696 A	24/04/97
		BR 9604432 A	23/06/98
		CA 2188208 A	20/04/97
		IT 1277204 B	05/11/97
		IT MI952154 A	21/04/97
		JP 9172449 A	30/06/97
		NZ 299605 A	19/12/97
		US 5903371 A	11/05/99
EP 0716521 A2	12/06/96	CA 2164778 A,C	10/06/96
		DE 716521 T	04/03/99
		IT 1267645 B	07/02/97
		IT T0941008 A	10/06/96
		JP 8237195 A	13/09/96
		US 5647035 A	08/07/97
US 5546403 A	13/08/96	JP 6284141 A	07/10/94

## 02/12/99

PCT/SE 99/00993

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0788249 A1	06/08/97	AU 1246897 A	14/08/97
		BR 9700189 A	29/09/98
		CA 2196121 A	06/08/97
		CA 2200382 A	19/09/97
		EP 0796969 A	24/09/97
		IT 1282063 B	09/03/98
		IT MI960199 A,U	05/08/97
		NZ 314182 A	24/10/97
		US 5822832 A	20/10/98
		US 5956319 A	21/09/99